



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

# **GM-TARDEC Vehicle Intelligence Collaboration Meeting**

December 16, 2010

Report Documentation Page			Form Approved OMB No. 0704-0188		
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1. REPORT DATE <b>16 DEC 2010</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>GM-TARDEC Vehicle Intelligence Collaboration Meeting</b>			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) <b>Andrea Simon</b>			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA</b>			8. PERFORMING ORGANIZATION REPORT NUMBER <b>21423</b>		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) <b>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA</b>			10. SPONSOR/MONITOR'S ACRONYM(S) <b>TACOM/TARDEC/RDECOM</b>		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S) <b>21423</b>		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>Previously submitted on 1/19/2011 edoc_1295454021 no record of archival in DTIC, The original document contains color images.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>	18. NUMBER OF PAGES <b>15</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

- Provides full life-cycle engineering support and is provider-of-first-choice for all DOD ground combat and combat support vehicle systems.
- Develops and integrates the right technology solutions to improve Current Force effectiveness and provide superior capabilities for the Future Force.

*Ground Systems Integrator  
for the Department of Defense*



Responsible for Research, Development and Engineering Support to **2,800** Army systems and many of the Army's and DOD's Top Joint Warfighter Development Programs

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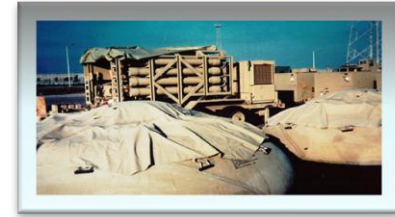




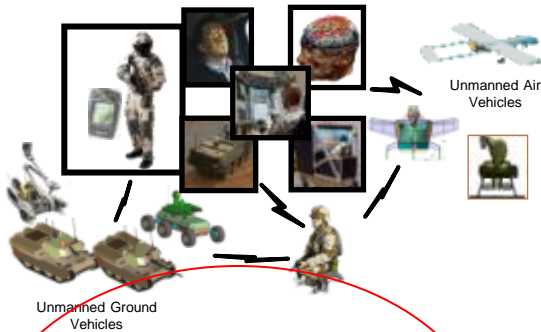
**Ground Systems  
Power & Mobility Integration**



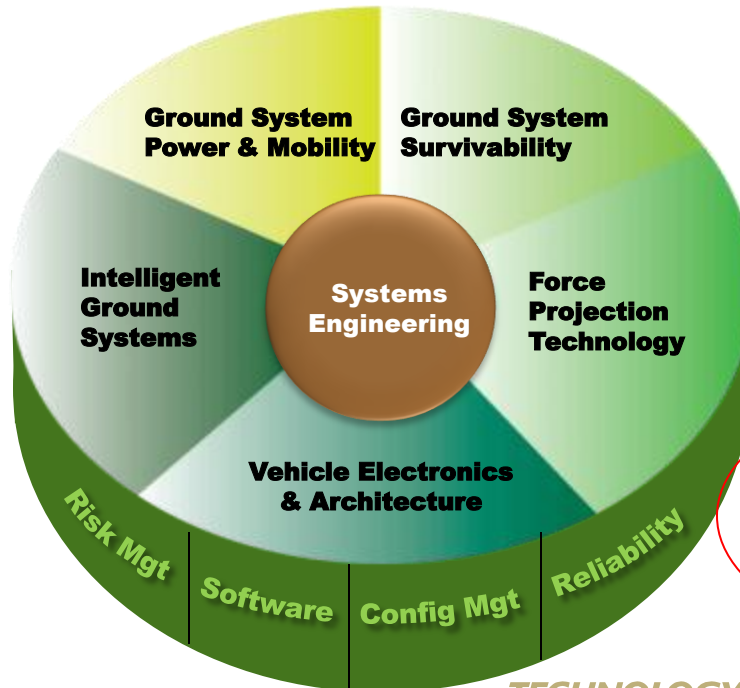
**Ground Systems  
Survivability Integration**



**Development of  
Force Projection Technology**



**Maturation of Ground  
Robotics &  
Vehicle Situational  
Awareness**



**Vehicle Electronics &  
Architecture Integration**

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- **High speed mobility**

- Improved high speed, high accuracy perception & actuation

- Reliable, scalable data fusion

- **Safe operations**

- Safety Assessment and Certification for Autonomous Systems

- Detect & classify stationary people & objects

- Collision avoidance & route planning

- **Design for tactical behavior flexibility**

- Understanding of environments

- Decision processing & workload management

- Expected & rational behaviors in new scenarios

- **Collaboration**

- Conduct collaborative missions with mixed manned/unmanned force

- Collaborative air-ground operations

- Low latency, High Bandwidth Communications



# Technical Approach



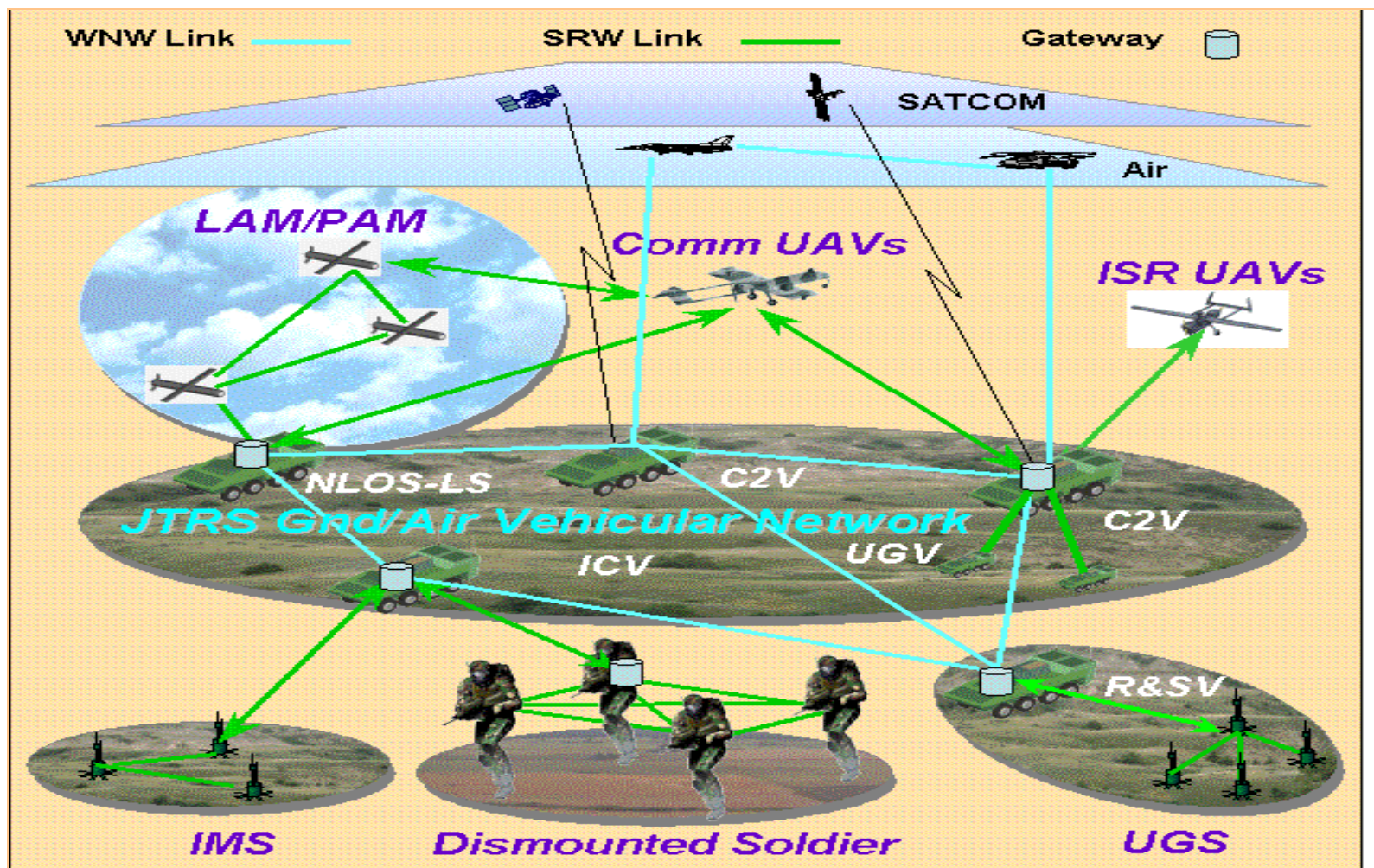
- Develop the tools, techniques, and autonomy “kits” to maximize mounted and dismounted control of UMS and optimize Soldier-robot and robot-robot ground & air teams.
- Use of Benchmarking and Design to Requirements.
- Focus on “affordable” technologies- sensors & sensor fusion, actuators, autonomy & by-wire conversion kits as well as information sharing with other vehicles & assets.
- Focus on robust, reliable, safety-critical architectures and designs.

## General Topic Areas for discussion:

- Connected Vehicle Technologies & Ad Hoc Vehicle Networks
  - High Bandwidth Communication Latency reduction techniques and methods
- Safety Critical Systems Design & Assessment
  - Testing methodology to certify autonomous systems “safe for Soldier use” needs to be developed.
- Conversion of existing platforms to UMS (By-Wire)
- Sensing Technologies
  - “Negative” Object Detection and Avoidance, etc
- HMI issues for manned/unmanned vehicle control
  - User monitoring, workload management, etc.

- **Army “market” is different from automotive**
  - Quantities much smaller : hundreds, thousands, tens of thousands of vehicles
  - Unit cost is much less important
  - Maintenance and “sustainment” costs are important
  - Supplier relations are more regulated and much more difficult
  - Unique requirements
    - Shipping by C130
    - Air drop
  - Many add-on systems in the field, little configuration mgt of vehicles
  - Vehicles are very old technology, by automotive stds: very little electronic vehicle controls (bowden cable accel pedal)

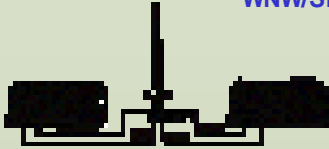




## LOW COST OTM COMMS

WNW/SRW TRI

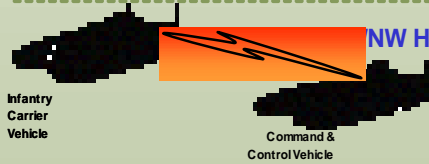
- BAND



PLATFORM  
ANTENNA  
REDUCTION

2 -PORT LOW PROFILE

REDUCED VISUAL  
SIGNATURES

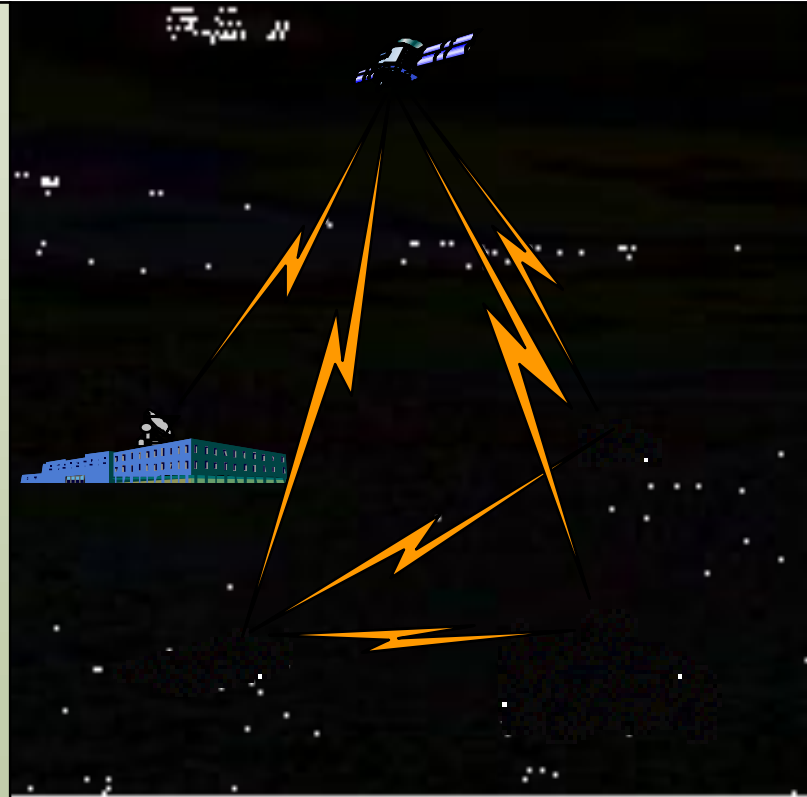


NW HIGH GAIN

IMPROVED  
LINK  
CONNECTIVITY

BODY WEARABLE

IMPROVED  
MANEUVER TACTICS  
& WIDEBAND COMMS



Tactical Network &  
Communications Antennas

Directional Antennas

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- **Issues**

- **Poor communications environment**
  - Lack of frequency regulation in some foreign countries
  - Jamming and active countermeasures
  - Cluttered, urban terrains
  - Many different communication devices on vehicles, little coordination between devices
- **Available power on vehicles is usually limited**
- **Robustness and maturity of technology**

- **Local Vehicle to Vehicle Communications**
  - Road conditions
  - Road Hazards
  - Emergency vehicle maneuvers
  - Distressed vehicle
  - Other local situational awareness items that can reduce the risk of other vehicles.

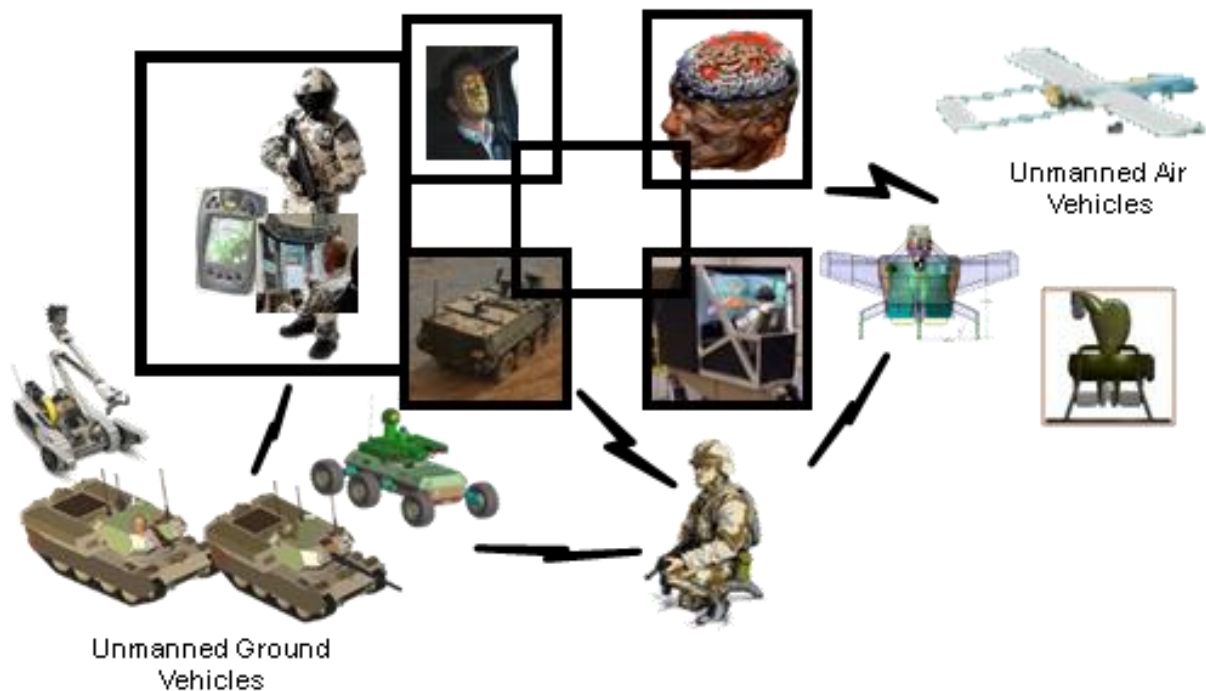
## Issues:

- **Measurement and definition of safety considerations**
  - Need to develop methods to perform standardized Safety Assessment and Certification for Autonomous Systems
- **Mix of analog, digital, and mechanical controls on vehicles**
- **Different vehicle configurations in the field – many unknowns**
- **Interaction of vehicle safety and survivability**
- **Interaction with Army Safety organizations**



- **Issues**

- **Measurement and definition of “autonomy”**
  - ALFUS
  - Future Combat Systems
- **Robustness of autonomous technologies**
- **Robustness of robotic platforms**
- **Trust in automation**
- **Lack of a detailed Army plan or strategy for development and introduction of technologies to the field**



- HMI issues for manned/unmanned vehicle control
  - Soldier workload is increasing as additional functions and technologies are being introduced
  - Multiple platforms & multiple functions per platform may exceed operator ability to control. Monitoring and managing workload is necessary, along with simplifying control and display data.
  - Motion sickness is also a consideration in many teleoperation/ autonomy functions.